

REMARKS

Claims 1, 2, 4-6 and 8-16 are pending in the application. Claims 1, 2, 4-6 and 8-16 are rejected. Claims 1, 8, 15, and 16 are currently amended. No new matter is entered upon entry of these claims or amendments.

Claim 1 is amended to specify that the first and second temperatures are different from one another.

Claim 8 is amended to refer to the nanopore size distribution of the first quantity of carbide-derived carbon.

Claim 15 is amended to clarify that subsequent temperatures differ from the first and second temperatures.

Claim 16 is amended to clarify that the tolerances associated with the finally produced sample is within 0.2 nm of the predetermined mean value.

I. Claim Rejections under 35 U.S.C. §112, second paragraph

Claims 8 stands rejected under 35 U.S.C. §112, second paragraph, as being allegedly indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. More particularly, the Examiner states that “Claim 8 contradicts claim 1, and reads upon the normal desired result of repeating an experiment to ge [sic] the same result, since claim 1 does not require that the two temperatures be different” (Office Action dated 12/30/09, page 2, paragraph 3).

The Applicants do not agree with the characterization that claim 8 fails to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Nevertheless, in an effort to advance prosecution, claims 1 and 8 have been amended to specify that the first and second temperatures are different from one another (claim 1) and to refer to the nanopore size distribution of the first quantity of carbide-derived carbon (claim 8). Applicants consider this action responsive to the Examiner’s rejection and ask that it be withdrawn.

II. Claim Rejections under 35 U.S.C. § 102(b) or 35 U.S.C. §103(a) – “Leis.”

Claims 1, 4-6, 8, 9, 11-16 stand rejected under 35 U.S.C. §102(b), as being allegedly anticipated by, or in the alternative, under 35 U.S.C. 103(a) as obvious over Leis J., *et al.*, “Carbon nanostructures produced by chlorinating aluminum carbide,” *Carbon*, 2001, 39, 2043-2048 (hereinafter “*Leis*”). The Examiner reiterates his remarks from an earlier office action that

Leis teaches on pg. 2043 reacting AlC and halogen gas at several temperatures. The teaching of Ti, Si carbide is noted. No difference is seen in the carbon product. No difference is seen in the product porosity. As to claim 16, writing down the results is obvious is not inherent in science and the mental steps ('correlating' and 'identifying') do not impart patentability. (Office Action dated 12/30/09, page 2, paragraph 5).

The Applicants disagree with the characterization that this reference anticipates or renders obvious the claims of the instant invention which describe a method of selecting a specific pore size within the constraints of the claims.

To show anticipation, the Office must prove, clearly and unequivocally, that each limitation of the pending claims is described in a single prior art reference. *Atofina v. Great Lakes Chem. Corp.*, 441 F.3d 991, 999 (Fed. Cir. 2006). “A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference.” MPEP 2131. Moreover, “[t]he invention must be shown in as complete detail as is contained in the . . . claim.” *Id.* In addition, “[t]he elements must be arranged as required by the claim.” *Id.* *Leis* fails to teach every element of the claim, arranged as required by the claims, in the complete detail required under 35 U.S.C. § 102.

Independent claim 1 of the present application (and accordingly all claims which depend on claim 1) contains the limitation that halogenating two samples of the same carbide material at two temperatures produces two nanoporous carbon samples whose mean nanopore diameter differs by in the range of 0.05 nm to about 0.2 nm. Nowhere in *Leis* is this feature described, either explicitly or implicitly, and the Office Action has failed to show where such teaching is made. At best, *Leis* discloses that halogenating a given set of carbide samples at different temperatures results in carbon samples whose nanopore sizes differ by the approximate thickness

of a graphitic layer; i.e., ca. 0.3 nm (e.g., Table 1). Since *Leis* does not disclose this limitation of claim 1, it cannot be said to anticipate.

Similarly, the standard for establishing a *prima facie* case of obviousness requires that three basic criteria *must* be met. First, there must be some suggestion or motivation, either in the reference itself or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on Applicants' disclosure. MPEP § 2143, *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438. Applicants submit that the Office Action does not set forth any of these requirements. Not only does the single *Leis* reference fail to teach or suggest all the claim limitations of the rejected claims, but the Examiner has failed to provide any suggestion or motivation, either in the reference itself or in the knowledge generally available to one of ordinary skill in the art, as to why the invention disclosed in *Leis* would be modified to produce the instant invention or that the skilled artisan would have any reason to expect success.

As to claim 16, the reasons given by the Examiner do not support a finding of either anticipation or obviousness.

For the foregoing reasons, Applicants respectfully request the Examiner to withdraw this rejection.

III. Claim Rejections under 35 U.S.C. § 103(a) – “*Leis*” taken with “*El-Raghy*.”

Claims 1, 2, 4-6, 8-16 stand rejected under 35 U.S.C. §103(a), as being allegedly unpatentable over *Leis J., et al., Carbon*, 2001, 39, 2043-2048 (hereinafter “*Leis*”), taken with *El-Raghy, et al., J. Appl. Phys.*, 1998, 83(1): 112-119 (hereinafter “*El-Raghy*”). Specifically, the Examiner remarks on page 2, lines 17-19:

Leis does not teach the compound of claim 2. El-Raghy teaches it as a composite of TiC and SiC. Using it as a source is an obvious expedient to make the desired carbon, noting

that Leis teaches carbide as useful materials in the introduction. (Office Action dated 12/30/09, page 2, paragraph 7).

Applicants disagree with this characterization. Referring again to the three-part standard for establishing a *prima facie* case of obviousness described above, even if the Applicants were to concede that the skilled artisan might be motivated to halogenate *El-Raghy's* composite of TiC and SiC (a point that the Applicants do not necessarily concede), the Examiner has not explained or demonstrated why the skilled artisan would reasonably expect success in replicating the claims at issue (i.e., changes in pore sizes of about 0.05 nm to about 0.2 nm), nor do either of these references contain all of the claim limitations described in the rejected claims. As such, the Examiner has failed to make out a *prima facie* case for obviousness, and the Applicants respectfully request reconsideration and withdrawal of the rejection

IV. Claim Rejections under 35 U.S.C. § 102(b) or 35 U.S.C. §103(a) – “Boehm”.

Claims 1, 4-6, 8-16 stand rejected under 35 U.S.C. §102(b), as being allegedly anticipated by or in the alternative, under 35 U.S.C. 103(a), as allegedly obvious over Boehm, *et al.*, Proc. 12th Biennial Conf. on Carbon, 1975, pp. 149-150 (hereinafter “Boehm”). Specifically, the Examiner remarks that “[p]age 149 teaches narrow-pore distribution carbon made from reacting TaC with [sic] at 500C. The results of several different temperatures are plotted and correlated.” (Office Action dated 12/30/09, page 2, last paragraph).

Once again referring to the requirements for a finding of anticipation, Applicants assert that the Examiner has failed to show that “each and every element as set forth in the claim is found, either expressly or inherently described, in [this] single prior art reference” and / or that the invention is “shown in as complete detail as is contained in the . . . claim.” Specifically, there is no teaching on page 149 of this reference that “nano-pore distribution carbon [can be] made from reacting TaC with [sic] at 500C.” The discussion on page 149 is limited to that of changes in crystallographic cell parameters, a feature not contained or correlated with nanopore size of the rejected claims. Even to the extent the page 150 (Figure 2) describes pore *volume*, it does not described nanopore *diameter*, as described in these claims. As such, *Boehm* does not

show that “each and every element as set forth in the claim,” and so does not anticipate the rejected claims.

Once again, referring to the three-part standard for establishing a *prima facie* case of obviousness described above, the fact that this single reference fails to teach or suggest all the claim limitations of the rejected claims is fatal to a finding of obviousness.

Accordingly, Applicants request reconsideration and withdrawal of the rejection.

V. Claim Rejections under 35 U.S.C. § 102(b) or 35 U.S.C. §103(a) – “Mohun”.

Claims 1, 4, 6, 8-14, and 16 stand rejected under 35 U.S.C. §102(b), as being allegedly anticipated by or in the alternative, under 35 U.S.C. 103(a), as allegedly obvious over Mohun, U.S. Patent 3,066,099 (hereinafter “*Mohun*”).

Specifically, the Examiner remarks that “[t]he reference teaches, especially in col. 6, 10, 35, and 36 heating SiC with chlorine at various temperatures to make a microporous material. No difference is seen in the pore distribution. . . . *Mohun* col. 6 indicates some predictability is well known.” (Office Action dated 12/30/09, page 3, 2nd paragraph).

Again referring to the requirements for a finding of anticipation or obviousness, Applicants assert that the Examiner has failed to show that “each and every element as set forth in the claim is found, either expressly or inherently described, in [this] prior art reference” and / or that the invention is “shown in as complete detail as is contained in the . . . claim.”

Mohun’s column 6 generally describes attributes of activated carbon but does not discuss reaction of SiC (or any carbide) with chlorine. In fact, this section appears to describe changes which occur in prior art chemistries (i.e., carbons formed by incomplete combustion and not halogenation of carbides). Any “predictability” expressed by *Mohun*, to the extent that it exists, does not appear to refer to carbons prepared by the methods of the present invention.

Mohun’s column 10 describes the reaction of SiC with chlorine to form activated carbon and SiCl₄, but provides no discussion as to the nature of the pore sizes or the ability to vary pore sizes with temperature (or any other parameter).

Mohun's columns 35 and 36 describe the results of chlorinating SiC at two temperatures and the resulting ash contents, electrical resistivities, vapor capacities, heats of wetting, and chlorine gas adsorption capacities, but do not describe or imply the limitations provided for the rejected claims.

Further, the Examiner's conclusion that "[n]o difference is seen in the pore distribution" is consistent with the fact that the Applicants are unable to find where pore distribution is even discussed in this reference. Applicants are unable to identify any teaching within *Mohun* which would suggest the limitations of any of the claims currently rejected on the basis of this reference. In the absence of such teaching, Applicants request reconsideration and withdrawal of the rejection.

VI. Concluding Remarks

Finally, the Office Action concludes with the statement that:

Applicant's arguments filed 9/9/09 have been fully considered but they are not persuasive. The arguments essentially are that the claimed process surprisingly gives a predictable result. However, the claims only require that different temperatures give different results and the references remaining demonstrate this, even though the various authors do not express and significance of these findings. (Office Action dated 12/30/09, page 3, 2nd paragraph).

The Applicants completely disagree with this conclusory characterization. First, as described extensively in their last response, Applicants are unaware of any predictability in the finding that carbides can be halogenated under conditions resulting in variations in pore sizes in the range of about 0.05 nm to about 0.2 nm; nor has the Examiner since provided any evidence of such predictability of result. The Applicants have described and supported their understanding of the prior art thinking that variations in nanopore sizes were subject to discrete "jumps" (or quanta), the distances of those "jumps" associated with the distance between graphitic layers; i.e., ca. 0.3-0.4 nm, such that the available pore sizes for a given carbide composition was limited to a finite number of pore sizes by the nature of the original carbide

composition. Their discovery of the “tunability” of such nanopore sizes was made in the face of this contrary thinking.

As stated previously, the Applicants assert that they have discovered that, through careful selection and *control of processing temperatures, for a given carbide* precursor, it is possible to control and define the nanopore sizes and nanopore size distributions of the resulting carbon articles, and that, within a given carbide composition, these nanopore sizes are not subject to

In but one example described previously, Federov (Mendeleev Chemistry Journal, 39 (6) pp. 87-87) describes the “chlorination of metal carbides at high temperatures is among the number of quite well-studied and assimilated processes in non-ferrous metallurgy and the chemical industry,” (page 88, line 3-4). Reporting on the range of work conducted at the Leningrad Institute of Technology during the period 1977-1992, which focused on the “[c]onditions of carbide chlorination . . . including a thermodynamic analysis of reactions and the experimental study of their kinetics as a function of such factors as temperature, reaction ratio, dispersion of carbides, and conditions of contact of carbide with chlorine,” describes *only* the impact of reaction ratio, dispersion of carbides, and conditions of contact of carbides with chlorine as they relate to final pore sizes.

Similarly, Gordeev, *et al.* (WO 98/54111, page 7, line 26 through page 8, line 20) describes *inter alia* the prevailing thinking until the present Applicants’ invention:

*Current notions of carbon material structure point out that nanopores generated during the thermochemical treatment process are **formed by ordered or disordered graphite planes of carbon**, which for simplicity might be considered as shaped slots, **the width of the latter depending on the type of carbide** used for forming of the workpiece with transport porosity.*

The same reference goes on to describe a formula for determining **nanopore sizes which depend exclusively on the nature of the carbide precursor**.

The Applicants discovered that it is possible to provide compositions from a given carbide precursor with much smaller differences, so as to “de-limit” the number of mean pore sizes available from a given carbide composition. In this way, it is possible to “tune” the final compositions, and such is implicit in the use of this term “tuneable.” The Applicants are unable to find any evidence that such nanopore “de-limited tuning” has been previously described by

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varying halogenation temperature, either explicitly cited or necessarily inherent in, or taught by any of the art cited by the Office. Nor has the Office provided any additional evidence of such prior art teaching.

Contrary to the Office's position that "the various authors do not express any significance in these findings," *Leis et al.*, one of the parties cited by the Examiner in this action, co-applied for a patent in this area (WO 2005/118471), acknowledging only after the present invention that "the peak pore size [can] be adjusted within a few angstroms by changing the carbide chlorination temperature," citing the present Applicants' work (page 1, lines 23-25). Additionally, as previously reported by the Applicants, R&D Magazine has recently described this finding as one of the revolutionary technologies of 2009.

For all of the foregoing reasons, Applicants submit that the pending rejections should be reconsidered and withdrawn. Accordingly, Applicants submit that all pending claims are in condition for allowance and earnestly solicit the Examiner to allow the application on the existing claims. Should the Examiner find that the claims are not in condition for allowance, Applicants request that he call the undersigned attorney at the number listed below to advance the prosecution of this application.

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